



## Smart Athletic Footwear For Muscle Comfort and Stability

*J.Rajeswari<sup>1</sup>, R.Nehemiah<sup>1</sup>, N.Premkumar<sup>1</sup>, Dr.Nalini<sup>2</sup>*

<sup>1</sup>UG student, Dept. of Biomedical Instrumentation, Dr. M.G.R. Educational and Research Institute, Maduravoyal, Chennai.

<sup>2</sup>Profesor, Dept. of Biomedical Instrumentation, Dr. M.G.R. Educational and Research Institute, Maduravoyal, Chennai.

### ABSTRACT

-The ankle joint joins the bones of the lower leg to the bones of the foot. The ankle joint permits the foot to move up and down. The lower leg contributes to postural control, and those who have had a visual or neuromuscular impairment have difficulty maintaining their balance. This necessitates the possession of tenacity and the ability to regain the lower limb. A remote sensor framework with Force Sensing Resistors (FSR) is constructed in this study to monitor the pressure of the foot as well as a sensor to measure blood pressure. For determining the pressure distribution beneath the foot, the remote sensors exhibited their excellent precision and constant quality. The discovered data is captured, and the data is then displayed on an Android device in a progressive manner.

Keywords – Ankle; Foot; Stability; Pressure.

### 1.INTRODUCTION

A lower leg sprain is a physical problem that affects the large groupings of tissue (tendons) that surround and connect the bones of the leg to the bones of the foot. The most well-known type of severe game injury is a lower leg ligamentous sprain.

The injury usually occurs when your lower leg is diverted in an odd manner by chance. The tendons that connect your lower leg bones and joints might be stretched or torn as a result of this. All tendons have a certain range of motion and limitations that allow them to maintain the joints balanced. An injury occurs when tendons are pulled beyond their limitations. Wounds to the tendons on the outside of the lower leg are common in hyperextended lower legs.

The major goal of this research is to develop a system that will help players recover from abrupt ankle sprains. Because this is a wearable instrument, it may be substituted with athletic footwear. In the event of a sudden ankle sprain, instead of icing, this shoe detects the sprain and begins massaging the affected area using the vibrator sensor. In this project, we're interested in making insoles more comfortable, which is done using three layers, as well as the accuracy of data from FSR sensors. The device's architecture is seen in Figure 1.

It's a fantastic tool for examining walking patterns and keeping track of players on the field of play.

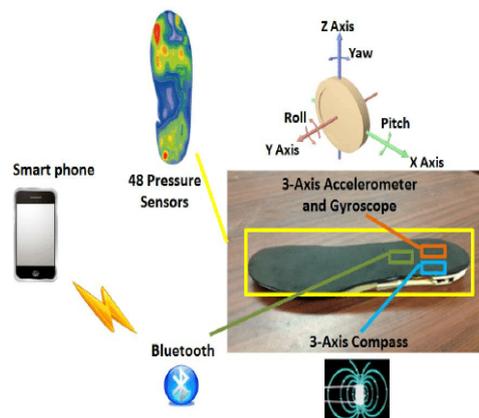


Fig 1:Architecture of the device

The framework includes a microcontroller installed on a low-power board that is dedicated to independent insertion frameworks. The device will assist hyper-extended people in intelligently planning for events and following the progress on their own phones. It will also give a data set with extricated bounds for the adviser to analyse the engagement and change the type of actions.

## 2. ANKLE SPRAIN

Sprains of the ankle are among the most frequent sports injuries. An ankle sprain occurs when the ligaments (tissue bands that link bones) that keep the ankle stable are injured. Ligaments on the sides of the ankle might stretch or tear if the ankle is suddenly twisted or rolled. A quick inward and downward movement of the foot strains the ligaments on the outside of the ankle, resulting in an ankle sprain.

Ankle sprains are more common among athletes who participate in sports that require fast changes of direction. Athletes who cut and pivot, such as those who play soccer, football, tennis, volleyball, and basketball, are particularly vulnerable. Athletes with a history of ankle sprains are also at a higher risk. Some athletes are more prone to re-injure their ankle if they return to their sport too soon after a sprain. There may be a loud "snap" or "crack" and immediate pain as the ankle turns. Swelling and bruising might appear suddenly. It may be difficult to walk depending on the severity of the sprain.

When walking becomes difficult or bones become uncomfortable in certain locations, x-rays may be used to check for fractured bones. Ice, anti-inflammatory medication, and ankle support in the form of a wrap, ankle brace, or walking boot are usually used to treat a minor ankle sprain. To prevent placing any weight on the damaged region, crutches may be required. Ankle sprains can be treated with specific exercises that focus on moving the joint, strengthening the ankle, and regaining balance. As the ankle begins to feel better, exercises that replicate ordinary activities (known as "functional exercises") can be begun to help avoid future ankle issues.

An athlete with an ankle sprain is more prone to sprain it again, especially within the first 6-12 months following the injury. There are, however, various strategies to avoid hurting the ankle. As a result, these shoes are designed to provide ankle support when participating in sports. Exercises that focus on balance and muscular control are also beneficial.

## 3. DEVICE MECHANISM

The gadget is made up of three layers, which are outlined below, to monitor foot pressure and provide stability and comfort

A. Pressure areas: The first subcaste is made up of three force detecting resistors that are utilised to monitor the bottom pressure. The detectors are located in high-pressure locations such as the forefoot, middle, and heel. We develop smart sneakers that monitor and store foot movements and, in the future, may potentially indicate the user's fitness level. A number of Force Sensing Resistor (FSR) sensors on the footwear are used to capture the walking patterns. In this paper, we discuss our efforts to develop a compressive pressure mechanism that connects the FSR stress sensor to the laptop as a platform for the development of smart footwear.

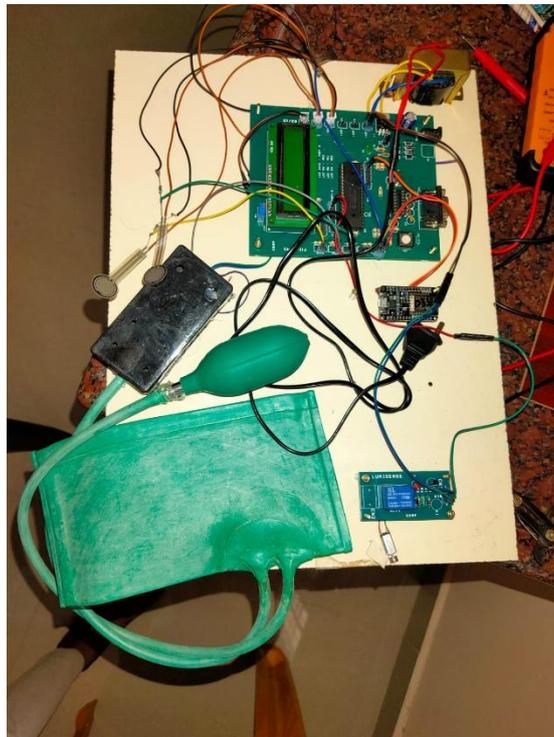


Fig 3: PROTOTYPE

B. Vibrating motor: The next layer is constructed with three vibrating motor which automatically starts to vibrate to produce stability. The microcontroller controls the vibration of the motors.

The vibration sample is modulated through 4 factors,

(1) location(s) of the motor(s) that vibrate.

- (2) the quantity of indicates it is vibrating. Vibration cycles for an instruction,  
 (3) length of a vibration,  
 (4) interval between two vibrations. Further, the pressure sensor serves as an extra change to manipulate on/off of the motors. Specifically, if needed, the motors will solely vibrate when the stepping pressure is increased than a threshold.

C. Blood pressure: The device also finds the blood pressure of the players and the sensed data is sent to the android based phone through Bluetooth. Many athletes suffer from poor circulation in their feet after a strenuous workout, and this would mitigate that discomfort.

#### 4. PROCESSING UNIT

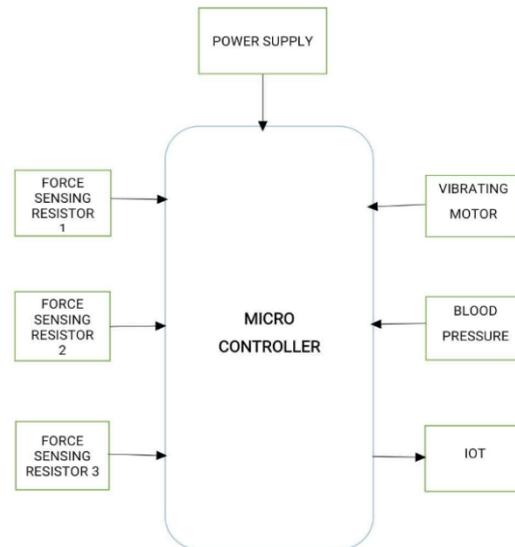


Fig 2: BLOCK DIAGRAM

The data from the sensors is sent through IOT from an Android-based phone. The Android application should be simple to use and provide a variety of information and clinical recommendations. All of the results were related with a Multiplexer, which was followed by an Analog/Digital Converter (ADC). The strain information is tested using a microcontroller installed on a board where the digitalized information pressures are altered as a result of the alignment interaction. The most recent data is sent over an IOT from an Android phone.

A motherboard connects all of the sensors to the Programmable interface controller board. The 4051 multiplexer on the PCB is used to connect the three FSR to the ADC. One battery serves as a charge regulator for the power supply. An association was introduced to select between two modes: the first associates the batteries in series to feed the controller installed on the Board, while the second associates them in parallel to be charged as well.

#### 5. CONCLUSION

In this work we have developed a wearable shoe for an ankle sprain. These shoes can effectively stabilize an unstable ankle and break the vicious circle of recurrent sprains. The developed shoe can measure the blood pressure as well as stability and starts giving massage through the vibrating sensor present.

#### REFERENCES

1. D. T. Fong, Y. Y. Chan, K. M. Mok, P. S. Yung, and K. M. Chan, "Understanding acute ankle ligamentous sprain injury in sports". *Sports Med. Arthrosc. Rehabil. Ther. Technol.*, vol. 1, p. 14, Jan. 2009.
2. Ben Moussa Zouita, O. Majdoub, H. Ferchichi, K. Grandy, C. Dziri, and F. Z. Ben Salah, "The effect of 8-weeks proprioceptive exercise program in postural sway and isokinetic strength of ankle sprains of Tunisian athletes". *Ann. Phys. Rehabil. Med.*, vol. 56, no. 9–10, pp. 634–43, Dec. 2013.
3. E. Eils and D. Rosenbaum, "A multi-station proprioceptive exercise program in patients with ankle instability," *Medicine & Science in Sports & Exercise*, vol. 33, n°12, pp. 1991-1998, 2001.

- 
4. S. Boukhenous, A. Benbakhti, A Touchen, M. Attari., "A 2DOF platform for ankle sprain rehabilitation.,". 10th International Conference on Electronics, Computer and Computation, ICECCO2013/IEEE, Ankara, Turkey, November 2013.
  5. GM. Gutierrez, CA. Knight, CB. Swanik, T. Roye, K. Manal, B. Caulfield, and TW. Kaminski, "Examining neuromuscular control during landings on a supinating platform in persons with and without ankle instability," Am J Sports Med. 2011
  6. Y. Lai, H. Lin, H. Pan, W. Chang, C. Hsu, and J. Renn, "Impact of foot progression angle on the distribution of plantar pressure in normal children," Clinical biomechanics (Bristol, Avon), vol. 29, no. 2,p. 196-200, February 2014